

NOTE

International study on *Artemia**. XXIX. Nutritional evaluation of *Artemia* nauplii from different geographical origin for the marine crustacean *Mysidopsis bahia*

Philippe Léger** and Patrick Sorgeloos***

Artemia Reference Center, State University of Ghent, J. Plateaustaat 22, Gent, Belgium

ABSTRACT: Freshly hatched nauplii from Reference *Artemia* and from 3 other *Artemia* strains were tested for their effects on survival, growth and reproductive characteristics of the crustacean *Mysidopsis bahia* (M.). The Reference, French (Lavalduc) and Chinese (Tientsin) strains produced significantly better results for all criteria tested than the Canadian strain (Chaplin Lake). Results are discussed together with those reported for other predators.

Until about 5 yr ago, 2 commercial *Artemia* cyst sources (USA and Canada) produced a world cyst supply of 30 to 50 metric tons yr⁻¹. Increasing demands for cysts by aquarium hobbyists and aquaculture hatcheries soon exceeded by far the amounts available. This induced a considerable price rise; at the same time, product quality became less and less reliable (Sorgeloos, 1979).

A solution to this problem was suggested at the 1976 FAO Technical Conference on Aquaculture, Kyoto, Japan: more *Artemia* biotopes should be considered for exploitation, either natural sources or sites where *Artemia* could be introduced artificially; better processing and hatching techniques should be adopted; and feeding of ongrown *Artemia* should be considered (Sorgeloos, 1979). These suggestions were taken up, and by 1980 at least 8 important commercial cyst suppliers (each producing more than 1 metric ton cysts yr⁻¹) offered about 60 metric tons of cysts yr⁻¹ (Sorgeloos, 1983). This larger offer resulted in considerable price reduction, better product quality and a more reliable supply. Soon, however, an unexpected disadvantage came to light, i.e. an important variation

in biological and nutritional effectiveness between *Artemia* cysts from different origins. Since the use of *Artemia* of inferior quality can result in incomprehensible experimental data and serious failures in aquaculture hatcheries, the characterisation of all commercial *Artemia* cyst sources would be beneficial for both scientists and commercial aquaculturists.

In view of this, an international interdisciplinary study 'International Study on *Artemia* (I.S.A.)' was initiated in 1978 (Sorgeloos, 1980) with the aim to characterize commercial *Artemia* strains. Up to now, 5 strains (San Pablo Bay, USA; Margherita di Savoia, Italy; Great Salt Lake, USA; Macau, Brazil; Shark Bay, Australia) have been examined for hatching characteristics, biometrics, genetics, biochemical composition, contamination and nutritional evaluation for different predators. Very significant differences have been reported for most characteristics studied. Last year the I.S.A. study was continued on 3 other commercial *Artemia* strains: i.e. Lavalduc, France; Tientsin, People's Republic of China; and Chaplin Lake, Canada – as well as on Reference *Artemia* cysts. The need for Reference *Artemia* cysts (R.A.C.) as calibration material in research experiments (culture tests, toxicological studies, fundamental research) was emphasized at the 1979 International Symposium on the Brine Shrimp *Artemia*, Corpus Christi, USA; samples of R.A.C. have recently been made available (Sorgeloos, 1981). In this note, we present results regarding the nutritional evaluation of nauplii from these 3 *Artemia* strains and Reference *Artemia* cysts for the marine crustacean *Mysidopsis bahia* (M.).

The *Artemia* strains tested and hatching conditions for obtaining Instar I-nauplii are listed in Table 1. Daily, freshly hatched *Artemia* nauplii were separated from their hatching debris by means of a separator box

* International Interdisciplinary Study on *Artemia* strains coordinated by the *Artemia* Reference Center, State University of Ghent, Belgium

** Research Assistant and *** Senior Research Associate at the National Fund for Scientific Research, Belgium

Table 1. *Artemia* cyst sources, naupliar lengths and hatching conditions. (Data provided by P. Vanhaecke, Artemia Reference Center)

<i>Artemia</i> strain (geographical origin, year of harvest)	Source	Average naupliar length (μm)	Temp. ($^{\circ}\text{C}$)	Salinity (ppt)	Incubation time (h)
Reference <i>Artemia</i> Cysts	<i>Artemia</i> Reference Center Ghent-Belgium	446.8	25	35	28
Lavalduc, France (1979)	Compagnie des Salins du Midi, Paris, France	509.0	25	35	30
Tientsin, P. R. China (1979)	China National Cereals, Oils & Foodstuffs Import & Export Corp., Tientsin, P. R. China	515.0	25	35	28
Chaplin Lake, Canada (1979)	Jungle Laboratories Corp. Comfort, USA	474.6	25	5	25

(Persoone and Sorgeloos, 1972), rinsed with fresh seawater and fed to freshly emerged juveniles of *Mysidopsis bahia*. The standard-culture test procedure with *M. bahia* was designed after Johns et al. (1981) and will be described elsewhere (Léger and Sorgeloos, in prep.).

Survival was recorded daily, and after 12 d growth and reproductive potential of pre-adult mysids were analysed. Data were treated statistically in a 1-way-

analysis of variance. Duncan's multiple range test was used to determine significant differences among means. Prior to analysis, survival data were normalized through arcsin $\sqrt{\%}$ -transformation (Snedecor and Cochran, 1967).

Table 2 and Fig. 1 indicate that optimal survival, growth and reproductive activity of *Mysidopsis bahia* is assured when juveniles are fed with Reference *Artemia*, Lavalduc and Tientsin nauplii. For all criteria

Table 2. *Mysidopsis bahia*. Survival and growth data for juveniles after 12 d of feeding freshly hatched *Artemia* nauplii from different origins

Parameter	Reference	Lavalduc	Tientsin	Chaplin Lake
% survival (\pm stand. dev.)	91.6 \pm 7.5	93.5 \pm 9.3	89.9 \pm 15.8	73.6** \pm 13.6
Individual dry weight (μg \pm stand. dev.)	318.8 \pm 44.3	294.4 \pm 20.8	295.5 \pm 23.9	251.3* \pm 41.2
Individual length (μm \pm stand. dev.)	4751 \pm 218	4686 \pm 295	4488 \pm 58	4103* \pm 171

*, **: Statistically different at * 0.05 level, ** 0.01 level

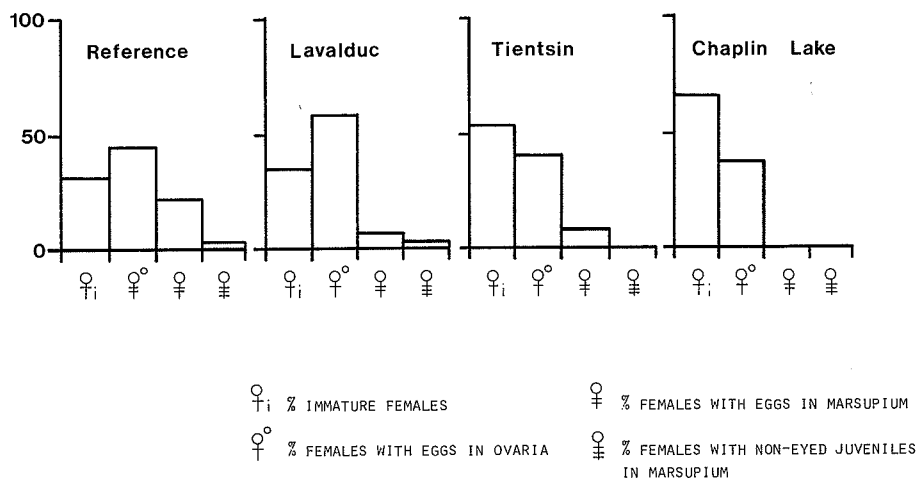


Fig. 1. *Mysidopsis bahia*. Reproductive potential after 12 d of cultivation, using *Artemia* from different origins as food source

tested significantly poorer results were obtained with a diet of Chaplin Lake *Artemia*.

Similar differences in food value between French and Chinese *Artemia*, respectively Canadian *Artemia*, were reported for different crab species by Goy and Costlow (1980) and Seidel et al. (1982) and for freshwater and marine fishes by Beck and Bengtson (1981), Klein MacPhee et al. (1982) and Vanhaecke and Sorgeloos (1983), provided that the fishes had grown to a size capable of ingesting the largest *Artemia* nauplii, e.g. those from French and Chinese origin.

Classical reasons for the poor nutritional value of specific *Artemia* sources (see review in Sorgeloos, 1983) are apparently not valid for Chaplin Lake *Artemia*, since Seidel et al. (1982) did not find significant differences in fatty acid profiles, nor in contamination levels. Vanhaecke et al. (1983), however, measured a significantly lower calorific content in Chaplin Lake *Artemia*. Furthermore, this is the only commercial *Artemia* source from a sulphate lake, all other *Artemia* cyst sources being harvested from chlorine waters. Prior to drawing conclusions on the impact of the latter 2 characteristics on the *Artemia* food value, culture tests and calorific content analyses should be made with *Artemia* from other sulphate lake sources.

In conclusion, *Artemia* nauplii from Lavalduc (France), Tientsin (People's Republic of China) and a Reference strain (R.A.C., Sorgeloos, 1981) support good survival, growth and reproductive potential of juvenile *Mysidopsis bahia*. Performances obtained with Chaplin Lake *Artemia* (Canada) are acceptable, but significantly inferior to results obtained with *Artemia* from other sources.

Reference *Artemia* nauplii are an excellent food source for *Mysidopsis bahia*, just as they are for the other marine and freshwater organisms tested so far. Hence, use of Reference *Artemia* is recommended as an intercalibration food source in toxicological and nutritional bio-assays.

LITERATURE CITED

- Beck, A. D., Bengtson, D. A. (1981). International study on *Artemia*. XXII. Nutrition in aquatic toxicology: diet quality of geographical strains of the brine shrimp *Artemia*. In: Pearson, J. G., Forster, D. B., Bishop, W. A. (ed.) Aquatic toxicology and hazard assessment: 5th Conf. Am. Soc. for Test. and Mat., ASTM STP 766, Philadelphia, USA
- Goy, J. W., Costlow, J. D. (1980). Nutritional effects of *Artemia* from different geographical strains on larval development of decapod crustaceans. *Am. zool.* 20 (4): 896
- Johns, D. M., Berry, W. J., Walton, W. (1981). International study on *Artemia*. XVI. Survival, growth and reproductive potential of the mysid, *Mysidopsis bahia* Molenock fed various geographical strains of the brine shrimp *Artemia*. *J. exp. mar. Biol. Ecol.* 53: 209-219
- Klein-MacPhee, G., Howell, W. H., Beck, A. D. (1982). Comparison of a reference strain and four geographical strains of *Artemia* as food for winter flounder (*Pseudopleuronectes americanus*) larvae. *Aquaculture* 29: 279-288
- Léger, Ph., Sorgeloos, P. (in prep.). Description of a standard culture test with larvae of *Mysidopsis bahia* Molenock (Crustacea, Mysidacea) for the evaluation of the nutritional value of live *Artemia* nauplii
- Persoone, G., Sorgeloos, P. (1972). An improved separator box for *Artemia* nauplii and other phototactic invertebrates. *Helgoländer wiss. Meeresunters.* 23: 243-247
- Seidel, C. R., Johns, D. M., Schauer, P. S., Olney, C. E. (1982). International study on *Artemia*. XXVI. Food value of nauplii from Reference *Artemia* cysts and four geographical collections of *Artemia* for mud crab larvae. *Mar. Ecol. Prog. Ser.* 8: 309-312
- Snedecor, G. W., Cochran, W. G. (1967). Statistical methods. The Iowa State University Press
- Sorgeloos, P. (1979). The brine shrimp, *Artemia salina*: a bottleneck in mariculture. In: Pillay, T. V. R. (ed.) FAO Technical Conference on Aquaculture, Kyoto 1976, Wm. A. Dill. Fishing News Books Ltd., Farnham, England
- Sorgeloos, P. (1980). The use of *Artemia* in aquaculture. In: Persoone, G., Sorgeloos, P., Roels, O., Jaspers, E. (ed.) The brine shrimp *Artemia*, Vol. 3, Ecology, culturing, use in aquaculture. Universa Press, Wetteren, Belgium, p. 25-46
- Sorgeloos, P. (1981). Availability of Reference *Artemia* Cysts. *Aquaculture* 23: 381-382
- Sorgeloos, P. (1983). Live animal food for larval rearing in aquaculture: the brine shrimp *Artemia*. In: Bilio, M., Rosenthal, H., Sindermann, C. J. (ed.) Realism in aquaculture: achievements, constraints, perspectives, in press
- Vanhaecke, P., Sorgeloos, P. (1983). International study on *Artemia*. XXX. Bio-economical evaluation of the nutritional value for carp (*Cyprinus carpio* L.) larvae of nine *Artemia* strains. *Aquaculture* 32: 285-293
- Vanhaecke, P., Lavens, P., Sorgeloos, P. (1983). International study on *Artemia*. XVIII. Energy consumption in cysts and early larval stages of various geographical strains of *Artemia*. *Annls Soc. r. zool. Belg.* 113: 155-164

Accepted for printing on November 9, 1983

